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COMPETITION AND CONFLICT:
WATER MANAGEMENT IN
THE JORDAN RIVER BASIN

by

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With the end of the Cold War, and the predictability of bi-polar power arrangements, the shape of global security will be required to change to face the emerging threats of the future. Changes to the global environment, through pollution, unrestrained population growth, and over-exploitation of existing resources, will be among these future threats. Regional security arrangements will be essential to controlling these threats, which know no territorial boundaries. It is the threat of conflict over water, in areas of scarce supply and surging populations, that forms the framework of analysis for this paper. One area in particular, the Jordan River basin, on the western Arabian Peninsula, is one of the most arid, populated regions on earth. Since the partitioning of the Arabian Peninsula, and the inclusion of a Jewish homeland in Palestine, this region has experienced conflict over water. This paper examines the situation in the region in terms of historical conflict over water, past attempts to manage supplies on a regional basis, and possible solutions to mitigate the potential for future conflict.

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COMPETITION AND CONFLICT: WATER MANAGEMENT IN THE JORDAN RIVER BASIN

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Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

With the end of the Cold War, and the predictability of bi-polar power arrangements, the shape of global security will be required to change to face the emerging threats of the future. Changes to the global environment, through pollution, unrestrained population growth, and over-exploitation of existing resources, will be among these future threats. Regional security arrangements will be essential to controlling these threats, which know no territorial boundaries. It is the threat of conflict over water, in areas of scarce supply and surging populations, that forms the framework of analysis for this paper. One area in particular, the Jordan River basin, on the western Arabian Peninsula, is one of the most arid, populated regions on earth. Since the partitioning of the Arabian Peninsula, and the inclusion of a Jewish homeland in Palestine, this region has experienced conflict over water. This paper examines the situation in the region in terms of historical conflict over water, past attempts to manage supplies on a regional basis, and possible solutions to mitigate the potential for future conflict.

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EXECUTIVE SUMMARY

With the end of the Cold War, and the predictability of bi-polar power arrangements, the shape of global security will be required to change to face the emerging threats of the future. Changes to the global environment - through pollution, unrestrained population growth, and over-exploitation of existing resources - will be among these future threats. The question then becomes: What shape will international security assume to fight these threats?

Regional security arrangements may provide the answer to controlling these environmental threats, which do not recognize territorial boundaries. One particular environmental problem that will need attention at the regional level is the threat of increasing competition for, and degradation of, regional water supplies. In areas of the developing world that are dominated by arid landscapes and few alternative sources of fresh water, the concern over existing supplies has been magnified. Since no country can hope to retain sovereignty, and/or increase development without ample amounts of this resource, it can often invoke strong emotional reactions from the state actors involved in the competition. According to Thomas Naff, in his essay "Water Scarcity, Resource Management, and Conflict in the Middle East", "...the strategic reality of water is that under circumstances of scarcity, it becomes a highly symbolic, contagious, aggregated, intense, salient, complicated, zero-sum, power- and prestige-

packed issue, highly prone to conflict and extremely difficult to resolve."

It is the threat of conflict over water, in areas of scarce supply and surging populations, that forms the framework of analysis for this paper. In the Middle East, growing populations, burgeoning industries, and expanding agricultural bases are competing for the same water supply. There are three major river systems in the region: the Tigris-Euphrates, the Nile, and the Jordan. The states of each river system are experiencing increasing competition for water resources and the potential for conflict between their co-riparian states. It is the competition over water in the Jordan River basin that is the subject of this thesis.

The Jordan River basin, located in the western Arabian Peninsula, is one of the most arid, populated regions on earth. Since the partitioning of the Arabian Peninsula by the League of Nations following World War I and the inclusion of a Jewish homeland in Palestine, this region has experienced conflict over water. The increasing competition for water between the four riparian states of the basin, Syria, Lebanon, Israel and Jordan, has produced threats of future conflict. In 1990 Jordanian King Hussein stated: "The only issue over which Jordan might go to war is the issue of water." While the peace process has made much progress in the region in the past few years, all four riparian states have not come to agreement on the issue of water use and distribution. Therefore, it is essential to be aware of the

factors that caused conflict in the past, historical attempts to manage water supplies on a regional basis, and possible solutions to mitigate the potential for future conflict.

Theories that analyze the connections between water and conflict point to simple resource scarcity and maldistribution as the main causes on conflict. However, environmental issues cannot be de-linked from more political, and less resolvable issues, such as Palestinian independence, when analyzing the potential for conflict. Regional agreements, and the intervention of international law can solve the problem of maldistribution. The problems of resource scarcity can be handled by understanding the proper role of water as an economic resource, and pricing it so as to increase efficiency of use; and by increasing investment in methods of acquiring new water supplies, and conserving existing supplies. However, these measures must be carried out in an integrated, regional fashion, with the full participation of all riparian states, and separate from the politics of regional conflict.

I. INTRODUCTION

The end of the Cold War has left questions in the minds of International Relations theorists regarding the quality of the subsequent "peace". In his essay, "Back to the Future, Instability in Europe after the Cold War," John Mearsheimer argues that the end of the bi-polar power arrangement, fostered by the Cold War, will lead to an increased chance of conflict in Europe. According to Mearsheimer, "...bipolarity, an equal military balance, and nuclear weapons have fostered peace in Europe over the past 45 years. The Cold War confrontation produced these phenomena; thus the Cold War was principally responsible for transforming a historically violent region into a very peaceful place." (Lynn-Jones, 1993, pp. 187)

Stephen Van Evera, in "Primed for Peace, Europe after the Cold War", takes the opposing view from Mearsheimer. Van Evera asserts that "the European wars of this century grew mainly from military factors and domestic conditions that are largely gone, and will not return in force." Therefore the shift from bi-polarity to multi-polarity will not increase the likelihood of war in Europe. (Lynn-Jones, 1993, pp. 195) In a related article, "Averting Anarchy in the New Europe," Jack Snyder proposes three views of the future that the end of the Cold War will inspire:

> Liberal "end of history" optimism envisions that...the sources of conflicts in Europe will be eliminated and peace will break out. Hobbesian pessimism anticipates a reversion to pre-1945 patterns of multi-polar instability and nationalism....a third view that is conditionally optimistic: neo-liberal institutionalism

> prescribes the implantation of cooperative international institutions as an antidote to the consequences of Hobbsian anarchy. (Lynn-Jones, 1993, pp. 104)

While the International Relations theorists quoted above are concerned primarily with post-Cold War instability in Europe, the end of bi-polarity will most assuredly change the patterns of power in a global fashion. As is evident by the dissention expressed by the "experts" the future arrangement of global security is unknown and possibly unstable. The question then becomes: What shape will international security assume, and in regard to what future threats?

With the end of bi-polarity and the ascension of multi-polarity, future security agreements may involve regional security. Existing regional security arrangements have been based on such practical considerations as economics, for example the European Economic Community or North American Free Trade Association; and have included more emotional issues such as the ethnic based Amerindian recovery taking place in Latin America. (Jackson, 1993, pp. 329) However, one issue that few regional security arrangements are currently addressing is the threat brought about by environmental changes. Such changes seldom affect only a single state and may often cross international boundaries. Therefore regional agreements will be necessary to mitigate the competition and/or conflict that may be produced by the efforts of sovereign states to control a perceived problem in ways most advantageous to their own national interests.

Robert Kaplan, in his Atlantic Monthly article "The Coming Anarchy" states definitively how he views the threat posed by environmental change:

> It is time to understand "the environment" for what it is: *the* national-security issue of the early twenty-first century. The political and strategic impact of surging populations, spreading disease, deforestation and soil erosion, water depletion, air pollution, and, possibly, rising sea levels in critical, overcrowded regions like the Nile Delta and Bangladesh--developments that will prompt mass migrations and, in turn, incite group conflicts--will be the core foreign-policy challenge from which most others will ultimately emanate, arousing the public and uniting assorted interest left over from the Cold War.

Kaplan's words bring about a series of fearful images of the anarchy that he sees encompassing a future world that refuses to come to grips with the importance of environmental change as a legitimate security issue.

One of the most pressing environmental issues, as cited by Kaplan, is the issue of regional water supplies; in terms of increasing competition for and degradation of these supplies. In areas of the developing world that are dominated by arid landscapes and few alternative sources of fresh water the concern over existing supplies has been magnified. Since no country can hope to retain sovereignty, and/or increase development without ample amounts of this resource, it can often invoke strong emotional reactions from the state actors involved in the competition. According to Thomas Naff, in his essay "Water Scarcity, Resource Management, and Conflict in the Middle East", "...the strategic reality of water is that under circumstances of scarcity, it becomes a highly symbolic, contagious, aggregated, in-

tense, salient, complicated, zero-sum, power- and prestige-packed issue, highly prone to conflict and extremely difficult to resolve."

In the Middle East, growing populations, burgeoning industries, and expanding agricultural bases are competing for the same water supply. The three major river basins in the region are all facing increasing competition from their riparian states. The Tigris-Euphrates river system, which provides water to Turkey, Syria and Iraq, has been the subject of much debate, as Turkey the upstream riparian builds massive dams on the headwaters, severely restricting the flow to the two downstream states. The downstream states of the Nile river basin, Egypt and Sudan, are fearful of the consequences of riverine development in Ethiopia, as that would restrict and diminish their vital water supplies. The competition for water in the Jordan River basin is also of concern to the co-riparians, and will be the subject of this paper.

The Jordan River basin has less water than almost any populated region on earth. It is the increasing competition for this water among its four riparian states, Syria, Lebanon, Israel and Jordan, that has in the past been the cause of conflict in the region, and has produced threats of future conflicts. In 1990 Jordanian King Hussein stated: "The only issue over which Jordan might go to war is the issue of water." (Hillel, 1994, pp. 267) Even in times of peace, competition over water could provide the spark to ignite renewed regional conflict if adequate

attempts are not made to improve methods for the acquisition of new water supplies and the management of existing supplies.

This paper will examine the water situation in the Jordan River basin beginning with a general background of the settlement of the area, Jordan River and ground water facts, and riparian water usage. Next there is a discussion of past and current attempts at water management and the conflicts that resulted from the region's inability to come to a unified consensus over water usage. The following chapter includes some of the theories concerning conflicts over water in general, and specific aspects of the possibility of conflict in the Jordan River basin. Chapter four discusses some of the ways in which water conflicts can be mitigated; including economic policies, and methods of acquiring additional supplies and conserving existing supplies.

II. BACKGROUND

A. REGIONAL DEVELOPMENT 1915-1948

During World War I, Britain made a series of "secret" promises and alliances that were not reconciled by postwar peace conferences. First, during the last six months of 1915, a series of letters were exchanged between Sir Henry McMahon and the Sharif Husayn of Mecca that promised the Arabs independence if they would revolt against the Ottoman Turks. Second, in November 1917 the British issued the Balfour Declaration, pledging to support a Jewish national home in Palestine. Third, the secret Sykes-Picot agreement between Britain, France, and Russia was drawn up, promising to divide the central Middle East between the three countries, with each power governing two areas. Britain and France would dominate the central Middle East from the Mediterranean to the Gulf. The "secret" Sykes-Picot agreement was exposed by the Russians following the 1917 Revolution, and the Arabs were outraged by the apparent double dealing of the British. Not only was Arab independence in jeopardy, but the Jews were to build a homeland on Arab soil.

With the end of hostilities in 1918, an Occupied Enemies Territories Administration (OETA) was established to administer the Ottoman territories pending a peace agreement. Delays in concluding a peace treaty, prompted Britain and France to convene the Supreme Council of the League of Nations. The Supreme Council announced, at San Remo in 1920, a system of mandates by

which the occupied territories would be governed until a peace agreement could be worked out. On behalf of the League of Nations, Britain and France took over the governance of the Arab lands of the former Ottoman Empire. The mandates for Lebanon and Syria were given to France, but Damascus had to be taken by the French using force. The mandates for the newly created Palestine, Transjordan, and Iraq, were given to Britain. Included in the terms for the mandate for Palestine, and endorsed by the Conference of San Remo, was the Balfour Declaration, allowing for the establishment of a Jewish national homeland in the area that was then known as Palestine. "With this, British wartime promises to support Arab independence in areas liberated from Turkish control were irrevocably broken." (Drysdale, 1985, pp. 63)

The inclusion of the Balfour Declaration in the treaty of San Remo opened up the area for the immigration of Jewish settlers and refugees of the First World War. The influx of Jewish immigrants into the area was of immediate concern to the Arab community, and in an effort to ease the tensions the British government imposed quotas on Jewish immigration in 1922. The attitude of the Jewish settlers was that, "in order to accumulate maximum territory, ever-increasing rates of immigration...were necessary, while extensive land purchases were perceived as essential for the absorption of both the ongoing immigration and the immigration the Zionist movement hoped for in the future." (Lowi, 1993, pp. 43) The Arabs however were of a different mind,

and viewed the scenario as one of Jewish encroachment on Arab lands: tensions continued.

In 1936 the British Colonial Office began to investigate the feasibility of dividing the area up into three parts: a Jewish state, an Arab state, and a British enclave. However that proposal never came to light, and it was not until 29 November 1947 the United Nations General Assembly voted in favor of another partition plan. This plan would partition Palestine into a Jewish state, an Arab state, and an internationalized Jerusalem. However, on 14 May 1948, one day before the planned British withdrawal from Palestine, Israel declared its sovereignty. The first Arab-Israel War began the following day, when armies from the neighboring Arab countries attacked the newly independent Jewish state. (Lowi, 1993, pp. 47)

By the end of the first war, Israel occupied 20 percent more land than had been allocated to it under the 1947 Partition Plan. Approximately 80 percent of the Arab population of the land that was now called Israel had fled or were expelled from the area. With regard to water resources, Israel gained the Dan Spring (one of the Jordan's headwaters), Lake Huleh, the Sea of Galilee, and part of the Dead Sea. The Kingdom of Jordan gained about 450,000 Palestinian refugees, and the dependance of some 400,000 Palestinians living on the West Bank. In less than two years the population of the Hashemite Kingdom of Jordan trebled.

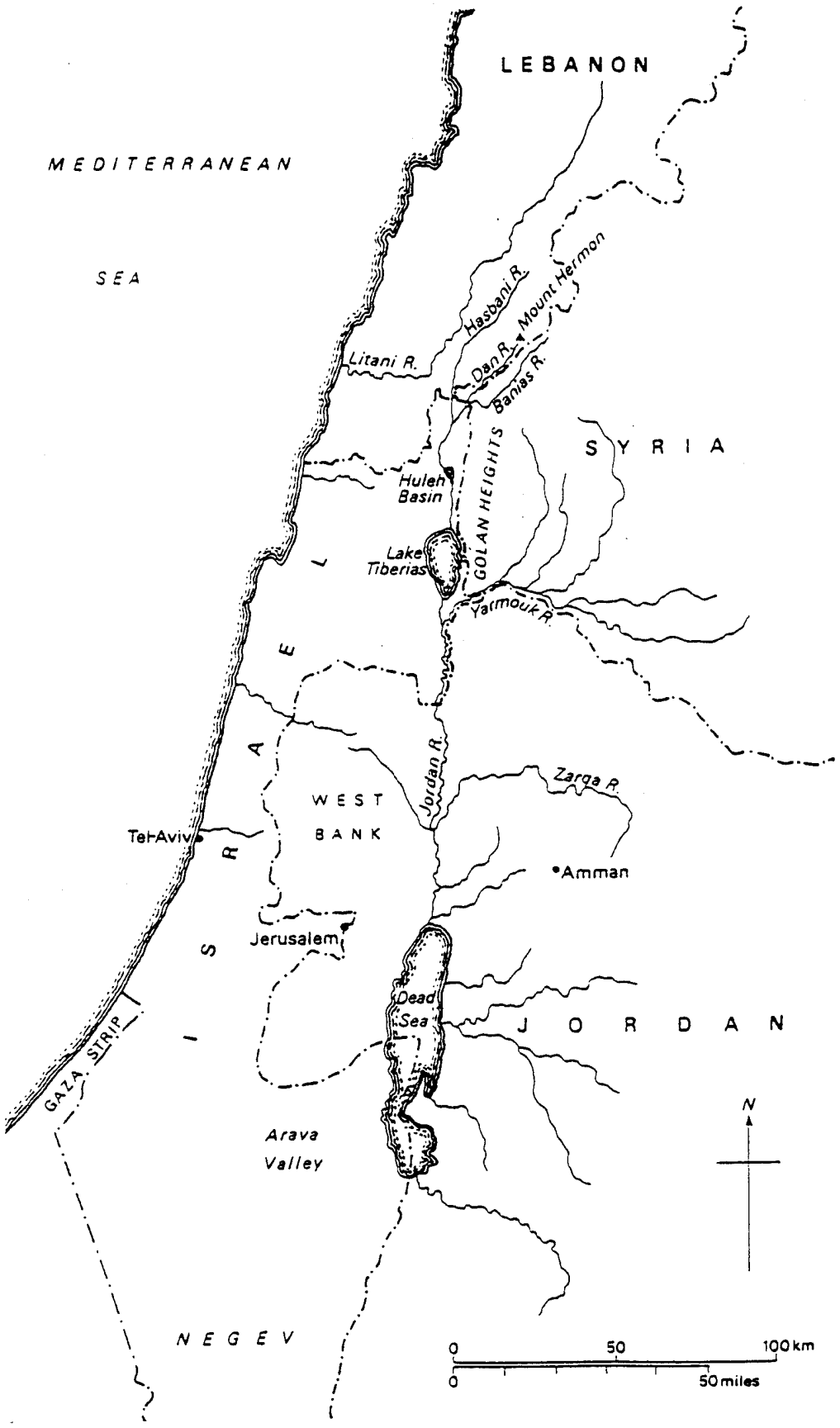
Israel's population also grew rapidly with the declaration of sovereignty and the removal of immigration restrictions. The

initial population when sovereignty was declared, 700,000 Jews, doubled within the first four years of Israel's existence. "The percentage of Jews in the total population of Palestine/Israel jumped from 30 percent in 1948 to 89 percent in 1951. By 1952, about 684,000 new immigrants had arrived from Europe and the Arab countries of the Middle East and North Africa." (Lowi, 1993, pp. 47) Both Israel and Jordan needed to begin rapid development to support the additions to their population figures. The Jordan River system figured high in their plans.

B. RIVER BASIN FACTS

The Jordan River basin is comprised of four riparian states, Lebanon, Syria, Israel and Jordan. This area of the Middle East has relatively little water, therefore competition is great and innovative water resource management has a high value. The total water availability of the Jordan River basin is greatly limited. The annual discharge of the Jordan River is only 1.2 billion cubic meters; a fraction of the water provided by the Nile's 84 billion cubic meter annual discharge.

The Upper Jordan, above the Sea of Galilee (also called Lake Tiberias or Lake Kinneret), has three main sources: (1) the Dan spring, originating near Israel's northern border, which provides 245 million cubic meters annually; (2) the Hasbani River, originating in southeast Lebanon, which delivers a flow that varies between 115 and 140 million cubic meters annually; (3) the Banias

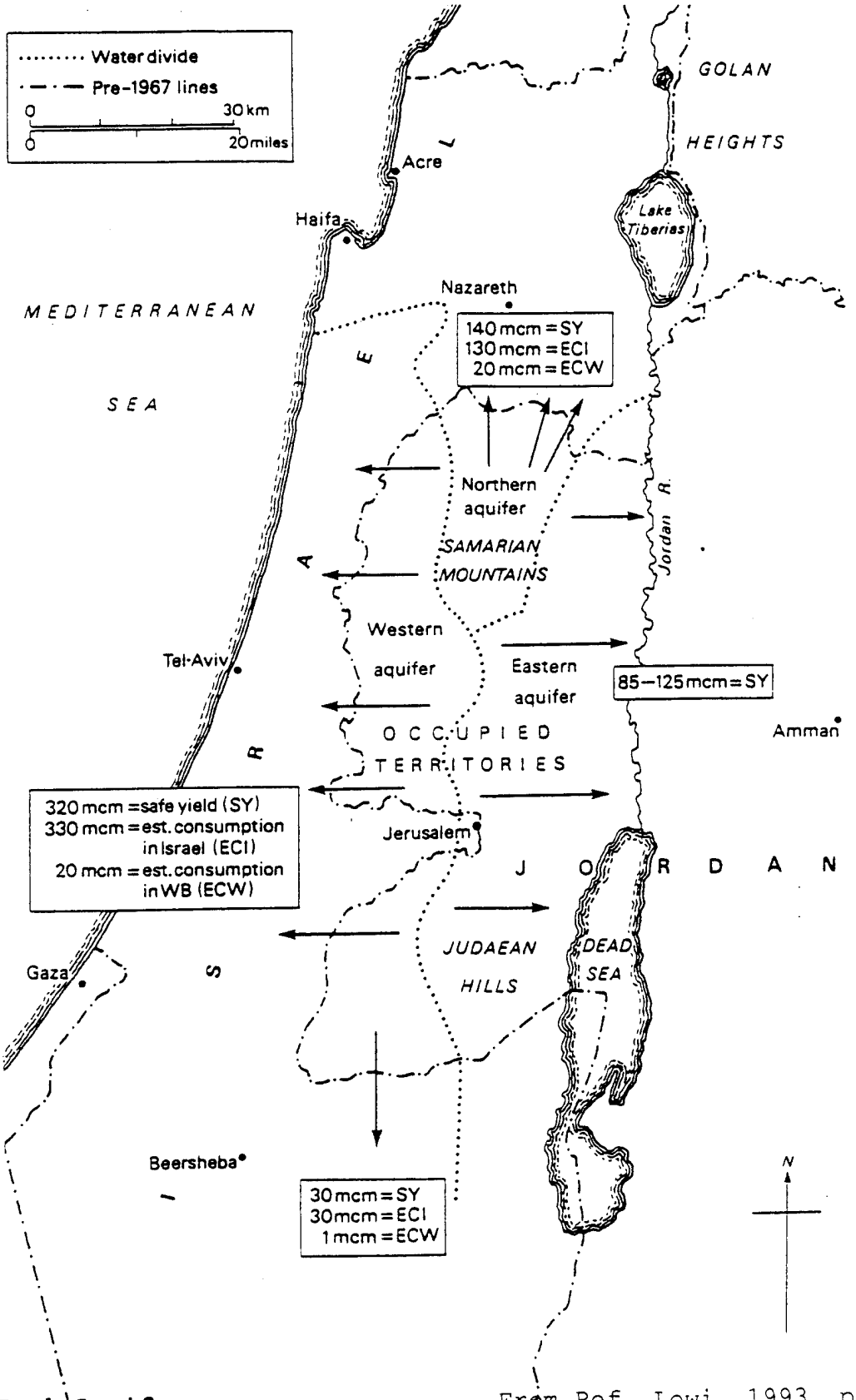


The Jordan River Basin From Ref. Lowi, 1993, pp. 24

River, originating in the Golan Heights, which delivers 120 million cubic meters annually. (Hillel, 1994, pp. 153)

The three principal sources of the upper Jordan converge in Israel, flow through the Huleh Basin, and plunge into the Sea of Galilee. The river that flows from the Sea of Galilee is referred to as the lower Jordan. The main tributary of the lower Jordan, the Yarmouk which flows from the east along the Syrian/Jordanian border, enters the Jordan a few kilometers south of the Sea of Galilee. The Yarmouk delivers approximately 475 million cubic meters annually into the lower Jordan. Farther to the south several other tributaries, including the Harod, Yabis, Faria, Zarqa and Nusayrat, join the lower Jordan. These tributaries provide varied, small amounts of additional water to the lower Jordan. From its starting point at the Sea of Galilee until it terminates in the Dead Sea, the lower Jordan flows approximately 100 kilometers.

Another major source of water for the region is ground water contained in aquifers, or water-bearing rock formations. Two important aquifers, located within Israel and the West Bank are the Coastal Plain Aquifer, running along the Mediterranean coast, and the Cenomanian-Turonian Aquifer, running under the mountains of Israel and West Bank straddling the Green Line (the 1949 temporary cease fire line separating Israel from Jordan). Both of these aquifers are considered renewable water resources. This indicates that they may be replenished by rainfall and artificial recharge. There are also aquifers in the region which are not



West Bank Aquifers

From Ref. Lowi, 1993, pp. 184

renewable and therefore are permanently diminished through regional exploitation. Ground water must be carefully managed because overuse can cause affects, such as seawater intrusion, which would decrease water quality and render it useless. (Drezon-Tepler, 1994, pp. 283)

C. RIPARIAN WATER USAGE

1. Israel

Over exploitation of available water sources has left the state of Israel with a water deficit. "According to a report by the State Comptroller in 1990, Israel's water deficit is principally attributable not to years of drought but rather to uncontrolled exploitation and mismanagement of resources and lack of institutional coordination." (Beschorner, 1992, pp. 10) Israel's estimated renewable annual freshwater resources are approximately 1600 million cubic meters. In 1990 Israeli water consumption was estimated at 1750 million cubic meters, with 1162 million cubic meters going to agriculture, 106 million cubic meters for industrial purposes and 482 million cubic meters for domestic use (Beschorner, 1992, pp. 11).

Approximately 380 million cubic meters of water are diverted annually from the Sea of Galilee into the country's National Water Carrier, to be distributed throughout the land. Israel also uses approximately 100 million cubic meters annually from the Yarmouk River. Ground water supplies 60 percent of Israel's needs, and sea-water intrusion into the coastal aquifer is now a

critical problem. With the water table constantly dropping, and the salinity increasing, many wells have become useless for drinking water and irrigation. (Ploss, 1992, pp. 20)

2. Jordan

The annual water supply of The Hashemite Kingdom of Jordan is approximately 800 million cubic meters. Of this total, 320 million cubic meters come from surface water (130 from the Yarmouk, 120 from the Jordan, the remaining 70 from small rivers and streams); 270 million cubic meters are derived from renewable ground water, and 210 million cubic meters from non-renewable ground water. Total Jordanian water consumption in 1990 was 743 million cubic meters; 360 of surface water and 383 of ground water. The water was allocated between the agricultural sector, 520 million cubic meters, the industrial sector, 70 million cubic meters, and the domestic sector, 175 million cubic meters. Jordan's Disi aquifer is at risk of depletion due to ground water consumption by the Kingdom's neighbor, Saudi Arabia. (Beschorner, 1992, pp. 16)

3. Syria

Syria is in control of the headwaters of the Yarmouk River; the source of much of Jordan's water. In 1991 Syria consumed 153 million cubic meters from the Yarmouk River. Plans for increases in irrigation could boost that consumption rate to 200 million cubic meters, and is the cause of concern for Jordan as it would reduce the amount of water available for irrigation in the northern highlands.(Beschorner, 1992, pp. 17)

4. Lebanon

The water supply of Lebanon is estimated at 4800 million cubic meters annually, garnered for the most part from 15 surface rivers. The country's total water consumption in 1991 was estimated at 900 million cubic meters; with 185 million cubic meters for domestic use, 35 million cubic meters for industrial use, and 670 million cubic meters for agricultural use. With a predicted population increase of 1.6 million by the year 2000, consumption rates are expected to rise to 1700 million cubic meters annually; divided between the domestic, industrial and agricultural sectors at 450, 120, and 1120 million cubic meters respectively. There is a great deal of Israeli interest in the possibility of water exportation from Lebanon. A plan which Lebanon has shown no interest in promoting. (Beschorner, 1992, pp. 18)

III. REGIONAL WATER MANAGEMENT

A. 1939 TO 1967

Beginning in the 1930's there has been no end to the number of proposed plans for the management of the Jordan River basin. Due to increasing competition for water, a result of the influx of migrants into the area after World War I, the various plans have attempted to alleviate the problems of water distribution, and therefore reduce tensions in the area. These past plans include: the Ionides Survey (1939), Lowdermilk Plan (1944), Hays Plan (1948), MacDonald Report (1951), Bunger Plan (1952), Israeli Seven-Year Plan (1953), Main/Unified Plan (1953), Cotton Plan (1954), Johnston Plan (1955), Israeli Ten-Year Plan/National Water Plan (1956), East Ghor Canal Stage I (1958).

1. Ionides Survey

In 1938, the Peel Commission, chartered by the British Colonial Office to investigate the tensions in Palestine between Arabs and Jewish settlers, commissioned a hydrographic survey of the Jordan Valley. The mission of this survey was to explore the potential for agricultural expansion and new settlement areas in the region. Irrigation engineer Michael Ionides completed this survey and published his results in his, "Report on the Water Resources of Transjordan and their Development."

Ionides concluded that the Jordan Valley, between the Sea of Galilee and the Dead Sea, if irrigated, could support new settlements. In his report Ionides stated:

> There is no escape from the conclusion that the only source of water on a scale large enough to affect the capacity of the country to any appreciable extent is from the two main rivers of the country, the Jordan and the Yarmouk. Therefore, the sole means of gaining a substantial increase in agricultural development, in the quantitative sense of providing room for increased population, lies in the canalization of the Jordan and Yarmouk. (Lowi, 1993, pp. 44)

In his plan, Ionides proposed irrigating the most fertile land in the Jordan Valley, the Terrace of the Ghor. This ancient sea bed stretches 100 kilometers from the Sea of Galilee in the north to the Dead Sea in the south. Ionides idea was to construct a canal alongside the Ghor, which would be used to divert water from the Jordan and the Yarmouk. He also suggested using the Sea of Galilee to store the winter flood waters of the Yarmouk river. While the plan was never implemented, due to the breakup of the Peel Commission, Ionides' ideas formed the basis for subsequent Arab river management/irrigation proposals.

2. Lowdermilk-Hays Plans

Dr. Walter Clay Lowdermilk, deputy chief of the U.S. Soil Conservation Service, visited Palestine in 1939 in the course of a worldwide soil erosion and conservation survey. During his visit Lowdermilk realized that the region had the need for a more efficient water and energy management plan. Lowdermilk conceived such a plan, and in 1944 it was published as Palestine: Land of Promise.

To increase water efficiency, Lowdermilk proposed the diversion of Yarmouk River waters to the edge of the Jordan Valley to be used for irrigation, and the diversion of the upper

Jordan to the coastal and northern Negev to irrigate that area. His plan to increase available energy centered around the fact that the Dead Sea is located 400 meters below sea level, in the deepest valley on the Earth's surface. Lowdermilk proposed a canal/tunnel to convey Mediterranean seawater into the rift, and then to use the force of the water, as it dropped 400 meters, to power hydroelectric plants.

In his plan, Lowdermilk called for the establishment of a Jordan Valley Authority, modeled after the Tennessee Valley Authority. He envisioned his plan as being beneficial to the people of both Palestine and Transjordan in the areas of water conservation, flood control, irrigation, drainage, soil reclamation and conservation, rangeland improvement, reforestation, and extraction of minerals from the Dead Sea (Hillel, 1994, pp. 159). Lowdermilk's plan was further elaborated by James Hays in his 1948 report: "T.V.A. on the Jordan." However, neither plan was ever implemented, partly due to regional conflict between the newly established state of Israel, and her Arab neighbors and also due to the fact that no understanding had been reached regarding the equitable allocation of Jordan River waters between the riparians.

3. MacDonald Report

The MacDonald Report, or "Report on the Proposed Extension of Irrigation in the Jordan Valley", was the irrigation scheme of the consulting firm, Sir Murdoch MacDonald and Partners, hired by Jordan in 1949. The report followed essentially the same recom-

mendations as the Ionides Survey; outlining a plan for the irrigation of both sides of the lower Jordan River. The firm stated in their report what was to become a fundamental issue in the management of Jordan River basin waters: "the waters in a catchment area should not be diverted outside that area unless the requirements of all those who use or genuinely intend to use the waters within the area have been satisfied." (Lowi, 1993, pp. 49) This assertion was in direct opposition to the principles by which the Israelis were developing their own water management plan: the Seven Year Plan.

4. Seven Year Plan

Inspired by the Lowdermilk-Hays plan, the Israeli government drew up its own national water management plan. The Seven Year Plan, published in 1953, had as its goal doubling the nation's water supply, thereby tripling the area of irrigated land, by 1961. The resulting increase in agricultural production was intended to support three-quarters of the total food requirements for a population of two million people.

The Plan would integrate "all the water resources of the country into a comprehensive country-wide network which would collect water wherever it is available and distribute it to the areas where it is needed." (Lowi, 1993, pp. 49) Included in the plan was a central irrigation system to draw water from the less arid north to the more arid south, as well as a plan to develop the hydroelectric potential of a Mediterranean-Dead Sea Canal, as first mentioned in the Lowdermilk plan. Contrary to the MacDona-

ld Report of Jordan, Israel's Seven Year Plan had every intention of removing water from the Jordan basin for use elsewhere in the country. Obviously there was not enough water in the Jordan system to support both plans. This fact only served to intensify tensions in the area with regard to water distribution.

5. Bunger Plan

Prior to the publication of the Seven Year Plan, the United States and the United Nations Relief and Works Agency (UNRWA) became interested in sponsoring a unilateral water plan for the Kingdom of Jordan. Both the United States and UNRWA had as their immediate concern the provision of relief for the mass of Arab refugees that were streaming into Jordan as a result of repeated clashes with the Israelis. The United States was also convinced that the Middle East was a vital bulwark in the defense against communism, and that efforts must be made to promote peace and stability in the area.

The Bunger Plan envisioned a joint Syrian-Jordanian built dam on the Yarmouk River at Maqarin, and a diversion canal along the East Ghor. The Plan was to provide irrigable land for the settlement of 100,000 refugees, and employment on the dam itself. One-fifth of the UNRWA budget was earmarked for the Plan, which was signed in March 1953. One month later work on the project commenced.

6. Unified Plan

Although the UNRWA was enthusiastic about the prospects for the Bunger Plan, it asked the U.S. Department of State to procure

a study for the unified development of the Jordan River system. "It explained its volte-face thus: it wanted to be assured that the Bunger project was the most economical, and that the funds it was about to commit 'would not be rendered nugatory by other projects undertaken by other interests in the same watershed.'" (Lowi, 1993, pp. 83) Thus in 1952 the firm of Charles T. Main Inc. of Boston, Mass. began to develop a plan for the management of Jordan River basin waters without regard for political boundaries. The emphasis of the Unified or "Main" Plan was irrigation and hydroelectric power production.

The Plan was presented to the UNRWA and the Government of the United States in August 1953, and to the riparian states in September of 1953. The report, which favored in-basin usage of Jordan River waters, included: (1) the irrigation of the Upper Jordan basin using the headwaters of the Jordan River, (2) the use of the Sea of Galilee to store flood flows of the Jordan and Yarmouk Rivers, (3) The irrigation of the Lower Jordan basin using canals along the east and west sides of the Jordan River south of the Sea of Galilee. The allocation of water between the riparians was proposed at 394 million cubic meters for Israel, 774 million cubic meters for Jordan, and 45 million cubic meters for Syria, for a total of 1,213 million cubic meters. The cost of the Unified Plan was estimated at $121 million dollars, most of which would be borne by the United States. (Lowi, 1993, pp. 86)

7. Johnston Plan

In 1953 Ambassador Eric Johnston, at the behest of President Eisenhower, traveled to the states of the Jordan River basin in an attempt to secure agreement for the unified management of the water system. The plan which originated as the Unified Plan thus came to be known, throughout its various iterations, as the Johnston Plan. Through separate negotiations with Israel and the Arab states during the 24 month period from October 1953 to October 1955, Ambassador Johnston completed a plan to provide distribution of surface water sources in the Jordan River basin. Although both parties agreed on the technical details of the plan, Johnston was never able to conclude a formal agreement due to Arab League resistance to a plan which would give Israel *de facto* recognition.

The Johnston formula allocated the following quantities:

> (1) To Lebanon: 35 million cubic meters/year from the Hasbani. (2) To Syria: 20, 22, and 90 million cubic meters/year from the Banias, upper Jordan, and Yarmouk headwaters, respectively. (3) To the Hashemite Kingdom: 100, 337, 243 million cubic meters/year from the lower Jordan, Yarmouk, and tributary wadis, respectively. (4) To Israel: 375 and 25 million cubic meters/year from the upper Jordan and the downstream Yarmouk, respectively. (Hillel, 1994, pp. 161)

The plan also included provisions for an engineering board and a water master to ensure that all parties were conforming to the agreed upon allocations.

One important factor that was overlooked in the plan was the allocation of ground water. The plan also contained a proviso allowing Israel to utilize seasonal overflows that were still

available after the other riparians had taken their shares. This proviso, which gave Israel a basis for historical water claims, was later to become important in future negotiations. While a formal agreement was not signed, both the Israelis and the Arabs continued to utilize many of the elements of the Johnston Plan in their water sharing attempts in the years following 1955.

8. Cotton Plan

The Cotton Plan was the alternative plan presented by Israel during the Johnston negotiations. It is important in that it presents one of the main points of continuing contention between Israeli water management desires, and those of the Arabs. In the Cotton Plan, additional water would be added to the Jordan River system by the diversion of the Litani River into the system. The Litani would provide additional fresh water to the Sea of Galilee to lower the salinity of the lake. The amount of water available for irrigation, under the Cotton Plan, was twice the amount than that of the Unified Plan. However this proposal cut the allocation for Jordan by 25 percent, Syria by 30 percent, while Israel's allocation more than tripled. The plan was unacceptable to the Arab states, both for the cutting of Jordan's and Syria's allocation and the inclusion of the Litani in the plan, a proposal to which the Arabs were adamantly opposed. The Cotton Plan died on the shelf with the rest of the Johnston negotiation proposals.

9. East Ghor Canal Stage I

Financed jointly by the governments of the United States and Jordan, the East Ghor Canal Project was designed to distribute water from the Yarmouk River to irrigate cultivable land along the eastern slopes of the Jordan Valley. Construction of the seventy kilometer main canal began in August of 1958. Additional stages of the project called for dams to be built at Mukheiba and Maqarin to hold the winter flood waters of the Yarmouk and to provide hydroelectric power. By June 1963 the first three stages of the project were completed, and 123 million cubic meters of Yarmouk water were being diverted annually for irrigation. "United States' support for the project was based on the fact that the amount of water to be diverted conformed with the quantities assigned to the Kingdom under the Unified Plan (1955)-." (Lowi, 1993, pp. 116)

10. Israeli Ten Year Plan

After the failed Johnston missions, Israel proceeded with its own water project, now dubbed the Ten Year Plan, or National Water Plan. After relocating the diversion point of the Jordan away from contested territory, Israel began construction on the main portion of the system: a 112 kilometer conduit extending from the northwestern shore of the Sea of Galilee to Rosh Ha'ayin east of Tel-Aviv. The main conduit would join the existing Yarkon-Negev pipelines in the south by the mid-1960's, and bring 150-180 million cubic meters of water annually to the coastal plain, and Negev desert. The final stage of the project envi-

sioned a diversion of 320 million cubic meters from the Sea of Galilee by 1970.

When the project was publicized by Israel, in June 1959, the Arab states reacted with immediate protests. "They perceived it as a violation of the rights of the Arab riparians and of those living within the basin, a violation of international law, and a profound threat to the security and survival of the Arab states." (Lowi, 1993, pp. 119) Israel was quick to defend its plan on the grounds that it fell within the water allotment that had been granted their country under the Johnston Plan. It was this very plan however that would exacerbate the Israeli-Arab conflict, and eventually bring the region to war in 1967.

At this point it would be useful to discuss the various conflicts that have occurred in the Jordan River basin, that the above attempts at water management had been unable to prevent.

B. WATER WAR

"There is an adage in the Middle East that war against Israel is impossible without Egypt and peace is impossible without Syria." (Neff, 1994, pp. 26) In his *Journal of Palestine Studies* article, "Israel-Syria: Conflict at the Jordan River, 1949-1967", Donald Neff asserts that Israel's continuing occupation of the Golan Heights, is one of the essential impediments to peace in the Jordan River basin. However, he argues that the key to the security issue that stands between the two countries is not the Golan Heights but rather the valley below where "the

runs through the midst of the Jordan river systems...." It is in the Upper Jordan River Valley that the three small demilitarized Zones (DMZs), created under the 1949 armistice between Israel and Syria, are located. These DMZ's have often been the focus of much regional conflict.

1. 1951 to 1956

The undisputed victor of the 1948 war, Israel gained 21 percent land more than had been allocated to it by the 1947 U.N. partition plan; 77 percent of the land of Palestine. Following the war nearly two-thirds of the original Palestinian population of Israel, 1.2 million people, were sent from their homes. In the northern sector, along the Jordan River, Syrian forces occupied a small part of what had once been mandate Palestine. This area of Syrian occupation was highly contested by the Israeli government. Israel was intent on retaining all the territory it occupied, but refused to allow the Syrians to remain in the areas they had occupied. The Israeli-Syrian Armistice agreement of 20 July 1949, brokered by UN Acting Mediator Ralph Bunche, created three Demilitarized Zones (DMZs) totalling 66.5 square miles along the Israeli-Syrian border. Syria was convinced to withdraw its troops, and in return received a pledge that sovereignty of the disputed areas would remain undetermined until a peace settlement was achieved.

The smallest of the DMZs, located in the northeast corner of the Israeli-Syrian frontier, was not inhabited but its land was used for farming and grazing. The central DMZ, a narrow strip

straddling the Jordan River, stretched from the southern edge of Lake Huleh to the northern tip of the Sea of Galilee. It held one Jewish settlement and four Palestinian villages. The third and largest DMZ in the southern part of the contested territory, extended from the middle of the eastern shore of the Sea of Galilee to the southern tip of the lake, then ran eastward to the Yarmouk River. The zone had one Jewish settlement, and three Palestinian villages. The rules of the armistice required the *status quo* be maintained in the zones, with neither side gaining military advantage from new projects. (Neff, 1994, pp. 27)

The United Nations Truce Supervision Organization (UNTSO), was made responsible for monitoring the DMZs. The armistice allowed for the creation of Mixed Armistice Commissions (MACs) comprised of two members each from Israel and Syria and a U.N. chairman who was either the UNTSO Chief of Staff or his designee. The mission of the MACs was to ensure "full implementation" of the armistice agreements. Dr. Ralph Bunche, the UN's Acting Mediator, provided both Israel and Syria with what he considered to be a proper interpretation of the agreements prior to the signing of the armistice. On 26 June 1949, Bunche wrote in what later became known to the parties and the United Nations as the "authoritative interpretation" that:

> Questions of permanent boundaries, territorial sovereignty, customs, trade relations and the like must be dealt with in the ultimate peace settlement and not in the armistice agreement. From the beginning of these negotiations our greatest difficulty has been to meet Israel's unqualified demand that the Syrian forces be withdrawn from Palestine. We have now, with very great effort, persuaded the Syrians to agree to this. I

> trust that this will not be undone by legalistic demands about broad principles of sovereignty and administration which in any case would be worked out in the practical operation of the scheme. (Neff, 1994, pp. 28)

The area remained quiet during the first two years the armistice was in effect, but it appeared that tensions were building. Jews moved into the area in increasing numbers, taking over land that had formerly belonged to Palestinians. Their actions greatly angered the Palestinian farmers living in the DMZs. Major General Carl von Horn of Sweden, who served as the fourth UNTSO Chief of Staff, described the situation:

> In 1950, the Israelis had established a new kibbutz at Belt Katzir in the southern demilitarized zone. Like most of their kibbutzim in troubled areas, it was fortified with trenches and a double-apron barbed-wire fence from behind which its settlers sallied out to cultivate the surrounding land, digging irrigation canals to channel the water from Lake Tiberias with such vigor that before long no Arab farmer in the area was allowed into the stretch of land between the kibbutz and the lake....Gradually, beneath the glowering eyes of the Syrians, who held the high ground overlooking the zone, the area had become a network of Israeli canals and irrigation channels edging up against and always encroaching on Arab-owned property.(Neff, 1994, pp. 29)

Tensions in the area heightened when, on 12 February 1951 Israel began work in a water project that included drainage of the 15,000 acre Huleh Marshes. Within a short time after the start of construction on the project it became clear that the Israeli drainage channels would impinge on Syrian territory within the central DMZ. Syria complained to the MAC, whose response was that the project "constitutes a flagrant violation" of the armistice. Asserting that they held sovereignty over the zone, Israel continued with the project on 25 March 1951.

Following a sniper attack on Israelis working on the water project, a clash broke out between the Israeli forces and Syrian troops and irregulars. No casualties were reported, however on 30 March Israel retaliated by forcing 785 Palestinians from their villages in the central DMZ and bulldozing their homes. (Neff, 1994, pp. 29)

On 4 April the crisis escalated even further, when seven Israeli soldiers on patrol in the southern DMZ were killed in an ambush by Syrian troops. The next day Israel launched an air strike inside the southernmost DMZ, killing two Palestinian women and wounding six civilians. Approximately 1200 Palestinians were forced out of their homes in the central and southern DMZs. On 2 may the Syrians retaliated by sending a force dressed as irregulars into and just west of the central DMZ at the northern tip of the Sea of Galilee. The Syrian and Israeli troops engaged and after a five-day fight, which took the lives of forty Israeli soldiers, the Syrians were repulsed. (Neff, 1994, pp. 30)

On 18 May the United Nations Security Council passed a resolution calling on Israel to stop their drainage project and to allow the return of those Palestinians that had been expelled from their homes in the DMZs. According to Lieutenant General William E. Riley, the current UNTSO Chief of Staff, in his report to the U.N. Security Council, only 350 Palestinians were allowed to return, and that efforts to return the others were prevented by Israel. Israel stopped work on the drainage project on 6 June

1951, but was allowed to continue a month later after it redesigned the project so as to avoid the contested territory

Following the resolution of the Lake Huleh drainage issue the area remained relatively calm for the next two years. But in 1953 the heat over water issues came on again when the United States entered the stage, as a mediator in the Jordan basin's water situation. As discussed earlier, it was the intent of the Eisenhower administration to foster peace in the Middle East by focusing on unifying regional water management. The Jordanians had been persuaded to shelve their Bunger Plan, in favor of the plan that was to be worked out by United States' representative Ambassador Johnston. However, a month before the scheduled October 1953 presentation of the American plan, Israel proceeded with a diversion project that included a nine-mile channel midway between the Huleh Marshes and the Sea of Galilee, in the Central DMZ. (Neff, 1994, pp. 31)

The project was initially billed as a small diversion to power a hydroelectric station on the shore of the Sea of Galilee, however UN observers believed the project to be too large for a minor generating station. The observers stated that, if completed, the canal would siphon off large amounts of Jordan River water, thereby precluded the United States' proposals for regional water management. Israel later reported that the intent of the canal was to divert enough water to help irrigate the coastal plain and eventually the Negev desert. Syria claimed

that the diversion of the water would result in drying up 12,000 acres of Syrian land. (Neff, 1994, pp. 31)

In an effort to force Israel to halt its diversion scheme, the United States informed Israeli officials, on 18 September 1953, that if work on the diversion did not stop the $26 million in pending aid would not be forthcoming. Originally, the Israelis were privately informed of the United States' intent to stop aid; no public announcement was made until 20 October 1953, in the face of Israeli refusals to halt work on the project. Secretary of State John Foster Dulles explained the United States' actions: "it seemed that if the United States granted economic aid under these circumstances, it would tend to undermine the authority of the United Nations Truce Organization." Dulles asserted that the authority of the U.N. was essential to the prevention of hostilities in the region. (Neff, 1994, pp. 31)

Major General Vagn Bennike of Denmark, the UNTSO Chief of Staff, stated in his report to the Secretary-General that the Israeli project had, by that time, denied water to two Palestinian water mills, causing them to cease work, and dried up some Palestinian farmland. Bennike's analysis of the situation, concluded, more importantly that control of the Jordan's flow gave Israel a substantial military benefit against Syria. According to Bennike, the deep bed of the river acted as a natural obstacle to soldiers and vehicles, and that the party that controlled the flow of the Jordan could control passage across the river bed. (Neff, 1994, pp. 32)

A week after the public announcement that the United States would withhold aid, on 27 October, the U.N. Security Council officially asked Israel to suspend work on the diversion plan. Within hours Israel agreed to suspend the project. The resumption of U.S. aid to Israel was announced on 29 October 1953. "Quietly, Washington kept the economic sanction in effect for the next three years, through 1956, by insisting on tying aid to Israel's behavior." (Neff, 1994, pp. 32)

2. 1957 to 1967

While Ambassador Johnston tried for three years to unify Jordan River basin water management, in the end he failed, and the riparian states were left to their own water management schemes. Israel continued with the construction of its canal, called the National Water Carrier, despite Arab opposition. Even though the start of the canal was moved from contested territory, to territory within Israeli boundaries, the compromise did not assuage the Arab state's basic objection to the withdrawal of Jordan River water for use outside the Jordan Valley. To the Arab states, the National Water Carrier plan represented not only a contravention of the rights of Arabs living in the Valley; it represented the strengthening of an enemy state who would now be in a position to absorb even greater numbers of Jewish immigrants, and increase its economic potential and industrial power.

In response to the Israeli plan, the Syrians planned to implement a counterdiversion of two tributaries of the upper Jordan. The waters were to be conveyed via canal over the Golan

plateau to a tributary of the Yarmouk River, stored by a dam at Muheiba and used by the Jordanians in the lower Jordan Valley. The plan was adopted by the Arab League in 1960, but continuous debate between the Arab states kept the plan at an impasse. The Syrians were not satisfied with a plan to divert waters; they pushed for an armed resolution to the Israeli water situation. The debate over the conflicting positions continued for four years.

During that time however, tensions continued to escalate and on 16 March 1962, devolved into violence. The incident involved fishing rights in the Sea of Galilee. After several exchanges of fire between armed Israeli patrol boats and Syrian troops on shore, Israel launched a raid on the village of Nuqayb in the central DMZ, where Syrian troops had taken up position. At least thirty Syrians and five Israelis were killed.

In January 1964 President Nasir of Egypt called a conference of Arab Kings and Heads of State. This conference cleared the air on several of the debated matters. First, $17.5 million would be set aside for the construction of the Jordan headwaters diversion plan. Second, $42 million would be contributed by the Arab states to fund a unified military command and reinforce the armies of Jordan, Lebanon and Syria. Third, the Arab states pledged to end their differences and cooperate on the issues of regional waters and the "Palestine Question." (Lowi, 1993, pp. 122)

In September 1964 the Arab leaders met once again. This meeting yielded the following results: (1) Work on the Jordan River diversion was set to begin at the end of the month; (2) Aggression against one Arab country would be considered as aggression against all; (3) The Palestine Liberation Organization (PLO) and the Palestine Liberation Army (PLA) were established to defend the interests of the Palestinian people. (Lowi, 1993 pp. 124)

The first border clash between Syria and Israel occurred within six weeks of the commencement of work on the Arab diversion. Both sides claimed the other was at fault. This clash marked "...the first in a series of military responses to rival water projects and conflicting political-economic aims and interests." (Lowi, 1993, pp. 125) While the conflict in the early part of 1965 was confined to the political arena, armed clashes resumed in the spring and summer months. By August 1965, both Israel and Syria brought the conflict to new heights through the use of air forces. Syria, however, did not receive the assistance of the planned joint military command, which seemed to have disappeared, and was left alone to fight the Israelis.

The conflicts that transpired in the summer of 1965 were not confined to the Israeli-Syrian border. Several confrontations occurred along the border between Israel and Jordan. Water installations, including the National Water Carrier were the subjects of attacks by men the Israelis believed were members of *al-Fatah*, a military wing of the PLO. Tensions in the region

continued to escalate throughout 1965 and into the winter of 1966. Israeli government officials while asserting that their first priority was regional peace, readied their country for the possibility of war by completing a large arms purchase from the United States in the winter of 1966.

The failure of the Arab states to come to the aid of Syria, as had been promised, and infighting between several other Arab states, resulted in the rapid disintegration of Arab unity throughout 1966. The states became divided into two camps, Egypt, the PLO and Syria versus Saudi Arabia and Jordan. In the midst of the dissention, fighting between Israel and Syria became more intense. By mid-July 1966, in reported retaliation for Palestinian *feda'iyin* sabotage against Israeli installations, the Israeli air force bombed the diversion works on the Banias-Yarmouk canal in Syria. A second air battle occurred one month later, resulting in the downing of two Syrian planes over the Sea of Galilee.

November 1966, brought more attacks, this time by Israeli troops against villages on the West Bank. These attacks were allegedly in retaliation for *feda'iyin* infiltrations from Jordan. Allegations that King Hussein was surreptitiously cooperating with the Israelis to wipe-out the *feda'iyin*, and his refusal to arm inhabitants of West Bank villages, fostered more discontent in the already splintering Arab community. With the downing of six more Syrian jets in an April 1967 confrontation, Israeli Prime Minister Levi Eshkol warned that "the miscalculation they

[Syrian leaders] were making regarding the extent of [our] patience was very dangerous for them." (Lowi, 1993, pp. 131)

With continuing armed skirmishes, the volatility of the region remained high. The internal Arab discord also continued, with Jordan accusing Egypt of abandoning Syria. In what became a pivotal move in the ongoing chess game of the region, Nasir of Egypt ordered the evacuation of United Nations Emergency Forces from the Sinai on 18 May 1967, and had his army take up positions along the border with Israel. Within days of this move, he went even further by blockading the Israeli shipping through the Gulf of Aqaba. The Israelis had previously announced that such an act would be a cause for war. Jordan and Egypt signed a defence pact at the end of May, and King Hussein gave permission for Iraqi and Saudi troops to enter Jordan. The government of Israel announced that the entry of troops into Jordan would violate the *status quo* and leave them no alternative but to defend themselves. On 5 June 1967, all states of the Middle East became involved in the third Arab-Israel war, or what would come to be known as the Six Day war.

As a result of the Six Day War, the Israelis gained control of the Golan Plateau, the headwaters of the Banias, and access to the intended site of the Muheiba Dam; allowing them to stop the planned diversion of the Yarmouk River waters. Although no other conflicts, including the 1973 War have been directly attributable to water, installations for water management in Syria, Israel, and Jordan continued to be thought of as strategic targets, and

were periodically attacked. The constant regional struggle has slowed the pace of water development, particularly in Jordan, where it is most needed.

C. POST 1967 WATER DEVELOPMENT

Water development continued in the region following the 1967 War at unilateral levels. The Israelis were successful in building and utilizing their National Water Carrier, and the Jordanian East Ghor Canal (renamed the King Abdullah Canal) extension was completed. Two projects, meant to increase the efficiency of Yarmouk River utilization, were blocked due to continued dissent among the riparian states: Maqarin Dam Plan (1975-1981), and the Unity Dam Plan (1987-1990)

1. Maqarin Dam Plan

In the late 1970's the Carter Administration attempted to assist the Jordan basin riparians in developing a regional water management plan, in the hope that it would lead to peace. The administration's plan was to dam the waters of the Yarmouk River at Maqarin, to enable the use of unutilized waters that had been flowing to the Dead Sea. Philip Habib, then assistant U.S. Secretary of State, worked on the Maqarin Dam Agreement for three years, but was unable to forge an agreement between the three riparians: Israel, Jordan and Syria. One of the conditions for U.S. funding of the project was the mutual agreement of the three riparian states to all aspects of the plan; absent such agreement the plan was essentially abandoned.

2. Unity Dam Plan

In the 1980's Syrian use of Yarmouk waters increased and began to be of concern to Jordan. As a result, in July 1987 Jordan signed an agreement with Syria for the construction of a dam on the Yarmouk river, giving Syria very favorable terms. The Unity Dam, to be built at Maqarin, would store 225 million cubic meters of Yarmouk water and would be used to generate electricity. Under the terms of the agreement, Syria would receive 75 percent of the electricity generated; Jordan would receive 180 million cubic meters of water and would bear the costs of construction. The funding for the project, $300 million, was refused by the World Bank due to a veto by Israel. The Israeli claim was that the project would interfere with its use of 15 percent of Yarmouk waters, and as a co-riparian they were able to stop World Bank action. The Unity Dam Project remains stalled and Israel has threatened to bomb the dam if it were ever built. (Beschorner, 1992, pp. 21)

3. Peace Treaty of 1994

At Arava Crossing, Israel on 26 October 1994, Jordan's King Hussein and Israel's Prime Minister Yitzhak Rabin signed a treaty for peace between their two countries. "With their treaty, the two sides settled long-standing land and water disputes, agreed to broad cooperation in tourism, trade and other areas, and pledged that neither would let its territory be used as a staging area by third countries for military strikes against the other." (Haberman, 1994, pp. A1)

Article 6 of the treaty, which deals specifically with water sets out the following provisions:

> With the view to achieving a comprehensive and lasting settlement of all water problems between them:
>
> 1. The parties agree mutually to recognize the rightful allocations of both of them in Jordan River and Yarmouk River waters and Arava/Araba ground water in accordance with the agreed acceptable principles, quantities and quality as set out in annex II, which shall be fully respected and complied with.
>
> 2. The Parties, recognizing the necessity to find a practical, just and agreed solution to their water problems and with the view that the subject of water can form the basis for the advancement of cooperation between them, jointly undertake to insure that the management and development of their water resources do not, in any way, harm the water resources of the other Party.
>
> 3. The parties recognize that their water resources are not sufficient to meet their needs. More water should be supplied for their use through various methods including projects of regional and international cooperation.
>
> 4. In light of paragraph 3, with the understanding that cooperation in water-related subjects would be to the benefit of both Parties and will help alleviate their water shortages and that water issues along their entire boundary must be dealt with in their totality, including the possibility of transfers, the Parties agree to search for ways to alleviate water shortage and to cooperate in the following fields:
>
> a. Development of existing and new water resources, increasing the water availability including cooperation of a regional basis as appropriate and minimizing waste of water resources through the chain of their uses.
>
> b. Prevention of contamination of water resources.
>
> c. Mutual assistance in the alleviation of water shortages.
>
> d. Transfer of information and joint research and development in water-related subjects and review of the potentials for enhancement of water resources development and use.

5. The implementation of both countries undertakings under this Article is detailed in annex II.

(Annex II is provided in the Appendix to this paper.)

The current treaty is very complete with regard to water management and distribution, and covers many areas of international law considered important in the success of regional management. However, this treaty has one major flaw, it only addresses the rights and responsibilities of two of the four Jordan River riparians. The refusal of Syria and Lebanon to engage in face to face talks with the Israelis over water issues will continue to be a problem for the future. As has been the experience of Egypt and Sudan, who concluded their Nile Waters Agreement of 1955 by dividing up the whole flow of the Nile without including the other riparian states, fears of increased water use by upstream riparians have become realized. At some future date the demands of upstream riparians, on water that Israel and Jordan have grown accostomed to using, may present difficulties in Jordan basin water management.

IV. STRATEGIC WATER

A. THEORIES OF WATER AND CONFLICT

1. Thomas Homer-Dixon

In his 1990 paper, "Environmental Change and Violent Conflict", Dr. Thomas Homer-Dixon, examined the question: "Will large-scale environmental changes produce violent national and international conflict?" Dr. Homer-Dixon states that there are seven environmental problems facing the developing world: greenhouse warming, ozone depletion, deforestation, acid deposition, degradation of agricultural land, overuse and pollution of water supplies, and depletion of fish stocks. According to his analysis there is a causal relationship between the social effects of these environmental problems and eventual conflict. The social conflicts that result from environmental problems include: 1. decrease in economic productivity; 2. changed regional agricultural production; 3. disruption of institutions and patterns of social behavior; and 4. population displacement (including environmental refugees and urban migration).

Homer-Dixon divides the types of conflict that may occur as a result of environmental problems into three categories: simple scarcity conflicts, group-identity conflicts, and relative-deprivation conflict. Simple scarcity conflict will arise over scarce resources, such as altered fresh water supplies, and is therefore most germane to this study. According to Dr. Homer-Dixon, such conflict results from the "rational calculation of

state actors in a zero-sum or negative-sum situation." He asserts that these conflicts are best explained and predicted by general structural theories which include microeconomics and game theory.

However, one of the problems that Homer-Dixon discusses regarding analysis of environmental problems as they relate to conflict is particularly important when looking at the Middle East. "Environmental problems and their social effects--including conflict--cannot be easily examined independently of other variables, including population growth, culture, and the prevailing institutional arrangements and social relations in a society." The variables that need to be included in analysis of conflict in the Middle East, specifically relationships between the Arab states and Israel, will most certainly complicate a simple environmental analysis.

2. Peter Gleick

Increasingly, the world is being faced with the problems of scarce resources, overpopulation, and conflict between developing countries. The question of the extent to which conflicts will arise as a result of the increasing competition for water is the topic of Peter Gleick's paper "Water and Conflict, Fresh Water Resources and International Security." According to Gleick, there are four characteristics which make water a likely source of strategic rivalry. They are: (1) the degree of scarcity, (2) the extent to which the water supply is shared by more than one

region or state, (3) the relative power of the basin states, and (4) the ease of access to alternative fresh water sources.

When these characteristics are applied to the Jordan basin it is not surprising to see that water in that region may well become a source of conflict. Water is most definitely scarce in the region. With growing populations, and a total river outflow of only 1.2 billion cubic meters annually, the overburdening Jordan River basin could worsen in the next 25 years. The water supply is shared by four states, the most needy of which, Jordan, is located on the downstream end of the river. The relative power of the basin states is the object of much contention, but based on the performance of individual states in the most recent military conflicts, it appears safe to say that Israel has the upper hand. And lastly, access to alternative fresh water is a pressing problem for the riparian states of the Jordan River, as it is for all Middle Eastern nations.

Gleick also points to the availability of water as a limiting factor in industrial development. He states that the rate at which these limits will be reach depends on three factors: (1) the absolute availability of water; (2) the population needing to be supplied: and (3) the level of development desired. Limits on industrial development will only promote and increase tensions between water-poor and water-rich nations.

According to Gleick, there is a definite link between water resource problems and conflict. "In most cases, resource inequities will lead to more poverty, shortened lives, and misery, but

not directly to violent conflict. But in some cases, these resource gaps will increase the likelihood of international disputes, create refugees who cross borders, and decrease the ability of a nation to resist economic and military activities by neighboring countries." (Gleick, 1993, pp. 92)

Peter Gleick uses a series of indices in his paper to measure water resource vulnerability. The first such index measures water withdrawals as a percentage of renewable water supply. According to this measure, countries which draw more than one-third of their total supply are in a vulnerable position. Jordan and Israel come out near the top of the list of high water use countries. Each country withdraws 110 percent of their renewable water supply annually.

The second index measures population growth, and the per capita availability of water in 1990 compared to the estimated per capita availability in 2025, based on current growth rates. According to this second index, both Jordan and Israel will experience severe water shortages in the near future. Jordan's per capita annual water availability is projected to drop from 260 cubic meters in 1990 to 80 cubic meters in 2025. The per capita water availability for Israel is projected at 470 cubic meters in 1990 dropping to 310 cubic meters in 2025.

The third index used by Gleick measures the extent to which water supplies are shared, and thus the potential for competition with regard to water resources. In this case both Jordan and Israel rank low on the list with only 36 and 21 percent respec-

tively of total river flow originating outside their borders. Of course in the case of Israel, the borders discussed are post 1967 and include the Golan Heights and Southern Lebanon Security Zone; both of which contain headwaters of the Jordan River.

The final index is the measure of a country's reliance on hydroelectric power as a fraction of total electrical supply. None of the Jordan River basin states appear on the list of countries evaluated, indicating that the reliance on hydroelectric power as a percentage of total electricity generated is less than 50 percent.

Another challenge to future water management in the Jordan basin is uncertainty concerning the effects of possible climate changes on water flows. Large-scale climate models for the Middle East show a large degree of uncertainty as to the nature of the climate changes and their severity. "For the region of the Jordan and Litani Rivers, three different climate models estimate that precipitation could change by an amount between -14 and +48 percent." (Gleick, 1994, pp. 6) The inconclusive nature of climactic predictions has added to the difficulty of water management in the region.

Applying Gleick's measures it appears likely that the Jordan River riparians are facing a situation which may result in conflict if measures are not taken to mitigate the affects of such factors as degree of scarcity, population growth, extent of resource sharing, and climactic changes.

3. Thomas Naff

In his 1993 essay, "Water Scarcity, Resource Management, and Conflict in the Middle East", Thomas Naff discusses the linkages between Middle East water resources and potential conflict. According to Naff: "Between 1995 and 2005, Israel, Jordan and the occupied territories could begin to experience acute and progressively worsening perennial water shortages and quality degradation analogous to the three areas running out of renewable sources of fresh-water." If this occurs it is conceivable that conflict could result. Dr. Naff does not envision outright warfare due to the disparity in power among the Jordan basin states, however, he does believe the shortages could lead to instability and internal civil unrest in the region.

Only through better management of water resources, does Naff believe the conflict that will result from water shortages can be avoided. In his analysis Naff lists eight factors that complicate water planning and management, they include:

- o Relationships of power, position and interest
- o Territorial and ownership disputes
- o Uncertainty about key facts
- o Political and ideological rivalries
- o Jurisdictional disputes stemming from the fact that watersheds and political boundaries are rarely coterminous
- o Absence of effective institutional legal machinery for settling riparian disputes
- o Ingrained tendency toward inaction without the motivation of a crisis

- Deeply rooted cultural and social attitudes toward water that make change difficult

Given the difficulties listed above, Naff's analysis focuses on "how to manage a scarce vital resource in conditions of bellicose rivalry while avoiding open conflict."

Given the inherent difficulties in managing water resources across international boundaries, Dr. Naff proposes that a basinwide water management authority be created to handle the issue. He also proposes that the riparian states, particularly Jordan and Israel reduce their irrigated agriculture by at least 40 percent. This amount would allow the states to break even with regard to supply and demand for water. However, this may prove difficult because, while it would be economically sound to lessen reliance on agriculture in favor of light industry, states such as Israel are in the business of agriculture for strategic, not economic reasons. Dr. Naff also asserts that continuous investment in technical improvements in water management and conservation is essential to ending the problems associated with water shortages in the region.

B. SUMMARY AND ANALYSIS

The aforementioned analyses certainly point to a number of factors that could lead to conflict between the states of the Jordan River basin. Thomas Homer-Dixon's broadbrush approach indicates that it is the condition of scarcity that will lead to conflict. However, as he stated, environmental problems cannot be divided from other variables when analyzing the probability of

conflict. In the Jordan River basin, the "other variables" include such issues as the question of a Palestinian homeland, and Arab non-recognition of Israel. Variables of great importance in the region, that, added to the issue of competition over water, could lead to conflict in the region.

Peter Glieck's analysis of the causes of conflict over water include factors such as: the degree of scarcity, the degree to which the water resource is shared, the possibility of changing water flows due to climate changes, the dramatic increases in population, and the difficulty in accessing alternative sources of water. All of those factors would lead to the belief that conflict over water in the Jordan River basin is likely. Thomas Naff's assertions are in agreement with those of Homer-Dixon and Glieck, in that the unavailability of water resources, combined with increasing competition, will lead to conflict if steps are not taken to ease the apparent water shortage.

In addition to the issues discussed above, the Jordan River basin is faced with other factors that may add to regional tensions. They include: control of headwaters and aquifers in occupied territories, threats to Syrian water supplies, and Lebanese denial of Israeli usage of water surpluses.

Regarding the issue of control of the aquifers and headwaters in the occupied territories, it is unlikely that Israel will be willing to relinquish its hold on the main sources of its water supply.

> Almost one-third of Israel's fresh water (130 billion gallons per year) is derived from aquifers in what

> Israel calls Judea and Samaria, and what the Arabs call the West Bank. Israel cannot survive, especially with the prospect of increased immigration and the natural population increase of both Jews and Arabs, without retaining access to this water or replacing it from some other source. That is a real security problem. (Ploss, 1992, pp. 20)

Therefore, control of the West Bank aquifers, and the headwaters of the Jordan located in the Golan Heights and Lebanon Southern Security Zone, will remain critical to Israel. Both Syria and Lebanon have expressed unwillingness to negotiate with Israel over water issues until Israel withdraws from these contested areas. (Beschorner, 1992, pp. 25)

A second factor which may be a cause for concern, for Jordan especially, is the possibility that Syria may be facing a threat to its Euphrates River water supply. Turkey is in the process of building a series of more than 20 dams on the rivers that provide the headwaters to the Euphrates. By the next century, when the $21 billion Great Anatolia Project in Turkey is completed the annual flow of the Euphrates River within Syria could potentially be reduced by as much as 12 billion cubic meters (Homer-Dixon, 1990, pp. 3). Additionally, the water will contain the fertilizers, pesticides and salts of the Turkish irrigation systems through which it will pass. If Syria turns to the Yarmouk River, on its border with Jordan for additional water supplies, Jordan's main source of water could be reduced. This would have a major impact on Jordan directly, affect Israel due to their water agreements with Jordan, and escalate regional tensions over water.

A third, but surely by no means final factor which could exacerbate regional tensions, is the refusal of the Lebanese to allow Israel to utilize apparent water surpluses from the Litani River. From the 1920's, when the details of the Balfour Declaration were being worked out, the Israelis have been insisting that the waters of the Litani are crucial to the economic survival of the Jewish state. Israel has attempted to include provisions for Litani River use in every major water negotiation, including the Johnston negotiations of the 1950's. The Lebanese have consistently refused to discuss any prospects for Israeli use of Litani water, and Lebanese hydrologists insist the there is in fact no surplus from which to draw.

Israel's relationship with Lebanon has steadily declined since the 1982 invasion, and the downfall of the Marionite Christian government, which Israel had supported. The Shiite Muslims that inhabit southern Lebanon continue to view Israel with enmity, and are unwilling to enter into negotiations with them over water. Despite persistent rumors that Israel is using its position in the Southern Lebanon Security Zone, to divert water from the Litani River, no evidence of such diversion has been produce (Beschorner, 1992, pp. 26). However, the inability of Israel to access what it views as wasted water surpluses, water that it so badly needs, will remain a sore point in the region and will continue as a source of tension.

Even in the face of much apparent tension, it is unlikely that conflict on a large scale, such as regional war, will break

out in the near future due to the disparity in military power among the riparian states; as Thomas Naff pointed out in his analysis. However, conflict on a smaller scale is certainly likely unless steps are taken to mitigate that conflict. There are, however, several factors which could serve to lessen or mitigate the potential for conflict. These factors include: regional water management treaties (as have been discussed previously), international water agreements, and high technology methods of conserving existing water and/or supplying the region with additional water. If these factors are properly implemented it may be possible to ensure that the Jordan River basin states do not place themselves in the position of resorting to armed conflict to protect existing water supplies, or gain additional, resources.

V. DECREASING THE RISK OF CONFLICT

A. INTERNATIONAL LAW

One way in which the risk of conflict can be lessened is through the implementation of international and regional water usage agreements. In 1991 the International Law Commission of the United Nations completed the Law of the Non-Navigational Uses of International Watercourses. This law set forth general principles for the use of shared waterways. These principles include: the equitable utilization of shared resources, the obligation not to cause harm to other riparian states, the obligation to notify and inform riparian nations of changes that would effect them, the obligation to share data, the obligation for cooperative river management, and the obligation to solve disputes peacefully.

Regarding the principle of equitable utilization, equitable in this case does not mean equal. The United Nations has allowed for a wide variety of factors, including population, geography, availability of alternative resources and so on, to be considered during negotiations over the allocation of water rights (Gleick, 1993, 107). With regard to the principle of prevention of significant harm to other states, harmful actions are permitted, but compensation or mitigation are required as alternatives to avoidance.

International Law requires that all disputes between countries be resolved peacefully, and this includes disputes over

water. However the success of International Law relies, to a large extent, on the cooperation of the nations involved in the dispute, and their willingness to submit to international decisions. Therefore, regional treaties between the states of the Jordan River basin may prove to be more effective in dealing with water disputes. Of course all riparian states must participate in water discussions, allowing technical agreements on water to be settled and "de-linked" from the question of Palestinian independence.

B. ECONOMIC IMPROVEMENTS

Water, as all other economic goods, will reach a natural price when equilibrium between supply and demand is achieved. The concept of scarcity with regard to water could be viewed, in terms of economics, as a resource for which the price has been kept artificially low therefore stimulating more demand, at the low price, than the available supply. As demand increases, the efficiency of water usage can be increased by allowing highly valued uses to bid in the market for the shares currently held by the less highly valued uses. Users could obtain more water if they are willing to pay the price.

One cost of water that may limit increases in a region's water supply is the cost of reclamation. "Water in a river may rush through a turbine at a dam, then be diverted to a factory for cooling purposes,...it may then enter a public water supply, be used domestically, be returned to ground via septic tank, and

be pumped up hundreds of miles away for irrigation purposes." (Hirshliefer, 1960, pp. 2) Since water is not limited to a single function for a given supply, its uses may be expanded given an investment in the technology necessary to do so.

Sound economic policies indicate that the proper use of a scarce resource is where it will produce the greatest benefits. In the case of agriculture in arid areas, especially the growth of high water consuming plants such as cotton and citrus fruits, the water used could be put to better use in other sectors of the economy. A 1990 report by the Israeli Comptroller specified the agricultural policies of the country as causing many of the current water problems. "The Comptroller's report cited the low price of water to the agricultural sector as the main culprit causing a decline in the water supply and distortions in the sector itself; the low price encouraged excessive pumping for the cultivation of crops which, by concealing a water subsidy, did not contribute to the country's real economic growth." (Drezon-Tepler, 1994, pp. 292) The low prices also created an artificial demand for increasing the water supply by implementing expensive waterworks projects whose cost could not be covered by the produce grown. The Comptroller's recommendations to correct the situation called for increased water prices, especially for agriculture, until they equal true cost, and the transfer of water system management from the Agriculture Ministry to an impartial government body.

The Comptroller's report validated the recommendations of a number of policy analysts who had previously counselled similar reforms in the water system. According to the analysts the country water management policies "...had not successfully allocated the commodity under conditions of water shortage to meet the competing demands of a developing, diversified economy." (Drezon-Tepler, 1994, pp. 292) Of immediate importance in the reform of the water system is raising the price of water to reflect the cost of supply. This rise in price, the analysts argue, would generate beneficial effects that would strengthen Israel economically and serve to alleviate tension in the area over water resources. An increase in the price of water would encourage Israeli farmers to reduce their consumption of irrigation water and adopt more efficient water-use technologies. The increase would also promote the transfer of water rights from low-value agricultural uses to higher-value industrial uses. To date Israel has replaced the Water Commissioner, and has taken some steps to raise the price, but much more work remains to be done. (Drezon-Tepler, 1994, pp. 292)

The water system in Jordan is in need of many of the same reforms as the Israeli system. Jordanian water expert, Elias Salameh, recommends "curtailing water for irrigation, reducing its subsidy and instead directing the resource to industry which earns more foreign currency."(Drezon-Tepler, 1994, pp. 292) In a region such as this, the scarcity of water demands that the employment of the resource yield a product valuable enough to

induce a profit over the cost of the investment; which clearly agriculture in Jordan does not.

C. INCREASING WATER SUPPLIES

Another way to lessen the risk of a regional conflict over water is to increase water supplies. There are only two feasible ways to increase water supplies: bring in new supplies, and/or capture unused portions of current supplies thereby increasing efficiency of water usage. The possible methods of acquiring additional water include: cloud seeding, desalinization, and water importation. The efficiency of current water supplies can be maximized by utilizing innovations in agriculture and wastewater treatment.

1. Cloud Seeding

Since the 1950's Israeli scientists have been experimenting with the practice of cloud seeding in an attempt to increase rainfall over their country. "The purpose of cloud seeding is to induce the formation within the cloud of crystals that can act as foci for the formation of raindrops and thus hasten the occurrence of rain." (Hillel, 1994, pp. 236) In 1961 the Israelis began systematic cloud seeding using silver iodide microcrystals to enhance rain formation.

The result of the first experiment (1961-67) produced an apparent 15 percent enhancement, while the second experiment (1969-75) produced an apparent 13 percent enhancement, over the target areas. Since 1975 the clouds over northern Israel have

been seeded on an operational basis. On certain days, with perfect cloud seeding conditions, the rain enhancement over the catchment area of the Sea of Galilee was increased by as much as 34 percent.

One possible downfall of cloud seeding is that by "milking" the rain out of the clouds over a specific area, the rain that might otherwise have fallen elsewhere could be affected. However, studies of Israeli cloud seeding have shown that areas of Jordan and Syria that lie downwind of the Israeli target areas have experienced increased, rather then diminished, rainfall. While research for further enhancement of rainfall will continue in the region, scientists realize that the method offers only limited potential for increasing the area's available water resources. (Hillel, 1994, pp. 39)

2. Desalinization

A possible sources of fresh water for the Jordan Valley region is desalinization. Actually a very old technique, taught by Aristotle and used by Julius Caesar, desalinization is the process of drawing fresh water from salty or brackish water. Several different methods are available including: distillation, freezing, electrodialysis, and reverse osmosis.

The distillation process is the most common method of desalinization. During this process salt water is evaporated, the steam is then gathered and recondensed to obtain pure water. The problem with the distillation process is that it requires a great amount of energy to vaporize water. It is therefore often

performed in conjunction with power plants, where excess heat can be used in the evaporation process.

An alternative to distillation, is to freeze the salt water, wash off the salty brine, then rethaw the ice to obtain water that is less salty, however not as pure as with distillation. Electrodialysis and reverse osmosis both utilize membranes to filter out the pure water from the saline. The difference between the two methods is with the force used to push the salt water through the membrane: electromotive force in the case of the former, mechanical force or pressure in the latter case.

Whichever method is used, it is the cost of desalinization that has kept the Jordan Valley states from further utilizing it to produce the resource they so desperately need. In 1985, the prototype for a large-scale desalting plant to be constructed at Ashdod, Israel was completed. The project, a joint U.S.-Israel venture, was abandoned because the high cost of energy needed to operate the plant made the process uneconomical(Ploss, 1992, pp. 21). The current cost of desalinized seawater ranges from 1 to 1.5 dollars per cubic meter. In Israel the cost of current fresh water (not desalted) supplies is in the range of .45 dollars per cubic meter. However, the price charged to farmers is .15 to .25 dollars per cubic meter while the price charged for industrial or domestic use is as much as twice the cost of the water. Therefore, while the price gap between current sources of water and water acquired through desalinization is closing,

desalinized water is still too expensive for agricultural use. (Hillel, 1994, pp. 253)

The only hope for the use of desalinization as the panacea of the region is to lower its cost. Through continued technical innovation, economies of scale, and more efficient use of energy, this cost may be brought down. One proposal that may provide the huge amount of energy necessary to provide the region with usable amounts of desalinized water is to create a canal from the Mediterranean, or the Red Sea, to the Dead Sea.

a. Med-Dead Project

The Dead Sea exists in the deepest rift on the Earth's surface: 400 meters below sea level. Water flowing through a canal would have to drop significantly to reach the Dead Sea, and in the process could be harnessed to power hydro-electric plants. Proposals for such a project date back to the late nineteenth century, when Theodore Herzl, a French engineer, first suggested it. Later, Walter Clay Lowdermilk revived the idea in his 1938 U.S. Department of Agriculture survey. Lowdermilk's proposal called for a seven mile concrete-lined canal plus a twenty-mile tunnel to carry sea water from the Mediterranean to the Dead Sea. The plan would produce 150,000 to 220,000 kilowatts of power, to serve the needs of 100,000 people. (Ploss, 1992, pp. 21)

Irwin Ploss and Jonathan Rubenstein, with the New York based Center for Research on Institutions and Social Policy Inc., have designed a 1990's version of the Med-Dead Plan. Their proposal includes the enlargement of the Dead Sea, from 400 to 800 square

miles, to provide a greater evaporation surface, and the construction of a 40 mile long passageway from Ashdod to the Dead Sea area south of Sodom, to transport Mediterranean seawater. According to calculations made by consultants on the project:

> A flow of water of 2.5 trillion gallons annually would enable turbines to generate 1000 megawatts of power, about three-fourths of the output of the Hoover Dam, and about one-fourth of Israel's present power use. The power would then be transmitted back to the Mediterranean shore, where it would be used to desalt 350 to 400 billion gallons of water per year, almost all of Israel's current water consumption. (Ploss, 1992, pp. 22)

Ploss and Rubenstein's plan would require the excavation of 440 miles adjacent to the Dead Sea for its enlargement; approximately 1500 times greater than the work required on the Panama Canal excavation. This would provide for a surface area of 840 square miles, and an annual evaporation 2.5 trillion gallons of Dead Sea water. The evaporation rate is critical to ensuring that the inflow would not exceed the outflow, raising the level of the Dead Sea, and reducing power generated.

There are several potential problems associated with the plan: the increased size of the Dead Sea would result in increased condensation, and therefore possibly increase humidity in the area; the saltiness of the Dead Sea would increase; there would be a change in the pressure over the rift as soil is replaced with rock. The degree of importance of each of these changes has not yet been analyzed, however Ploss and Rubenstein also point to the potential benefits of the plan. The most obvious benefit is the increase in water and power, to be shared

between Israelis, Jordanians and Palestinians. There would also be an increase in the employment opportunities in the area as the construction gets underway. The excavated material could be put to good use, creating a level plain for future solar energy production.

The plan is still in its infancy and will require several more years to complete the necessary studies, arrange financing, and assemble the specialists and the equipment. Then approximately ten additional years to complete the excavation, build the conduit and the generators, generate the power and begin desalinization. (Ploss, 1992, pp. 23) The plan is expected to cost several billions of dollars, and therefore would require financing from international sources. However, an analysis of the benefits derived from the plentiful supply of water to the region may show that the cost is indeed feasible.

b. Red-Dead Project

An alternate proposal to the Med-Dead project, is the Red-Dead project. This project would be similar to the Med-Dead, however the canal would transport water from the Red Sea, rather than the Mediterranean, to the Dead Sea. This is envisioned as a joint Israeli-Jordanian project, with international funding (at least $2 billion), that would contribute to tourism in the area, support a growth in farmed fish production, provide a Red Sea port for joint usage, and provide energy for desalinization. The project is estimated to take eight years to complete, however will not be ready for implementation until more detailed engi-

neering and economic plans have been worked out. (Peres, 1993, pp. 144)

3. Water Importation

a. Water Bags

One recent innovation that could be used to deliver new supplies of fresh water is to float in huge bags full of the needed liquid. The concept of towing bags is not new, but the new, larger size bag is a definite improvement on an old idea. "The difference now is that, rather than carrying up to 1000 cubic meters of water, new bags soon to be in production by the Medusa Corporation of Canada may be able to hold as much as 3.5 million cubic meters." (Scudder, 1994, pp. 13) The Turkish government has consulted with other makers of these water bags, and is offering treated water from the Malaygat river near Antaliya in southern Turkey for $0.08 per cubic meter. Initial estimates of the total cost of the towed water are between $0.60 and $0.70 per cubic meter, and would prove to be more cost effective than desalinization. (Scudder, 1994, pp. 13)

b. Water Pipelines

A second method of water importation is the utilization of a pipeline. In 1987 Turkish Prime Minister Turgut Ozal proposed a transnational water transfer plan, later dubbed the "Peace Pipeline." The plan called for two pipelines to carry water from southern Turkey to the Persian Gulf states in the east and to Saudi Arabia in the west. Along the route of the pipeline, water could be supplied to Syria, Iraq, Jordan and Israel. The prohib-

itive cost, $20 billion, the regional instability, and the time needed for construction, 10 years, were all factors contributing to the tabling of the plan for the near future.

A smaller version of the plan, called the "Mini-Peace Pipeline" is less grandiose than its predecessor and therefore may prove to be more feasible. This plan calls for the conveyance of water from Turkey only as far as Syria or Jordan, and would provide an additional 600 million cubic meters per year to the region. In favor of pipeline projects, Israeli Minister of Foreign Affairs Shimon Peres stated, "Pipelines for water, oil, and gas should be laid out with an economic rationale and not based on the old strategic worries." (Peres, 1993, pp. 129)

Another possible water transfer plan would divert water from the Litani river in Lebanon to Jordan. Such a transfer could provide as much as 100 million cubic meters annually to the Jordanians. However, the feasibility of this project is dependant on peace between the two states, as well as adequate compensatory measures for the Lebanese.

D. CONSERVING EXISTING WATER SUPPLIES

1. Agricultural Innovations

Hydrologists agree that the single most water-consuming human activity is agriculture. With the exception of Israel, where new technologies are used, most of the irrigation methods currently in use in the Middle East are wasteful. "Some estimates suggest that 70 percent of total water use, and 90 percent

of irretrievable consumptive use of water, is due to irrigation." (Mathews, 1992, pp. 26) City dwellers in need of sanitary drinking water are finding themselves in competition with farmers over scarce resource supplies. Therefore it is incumbent upon the region to utilize the water saving technologies that have been developed in places like Israel and California if they are going to continue to pursue local agriculture.

Among the technologies currently available is drip irrigation. This method, used in Israel and recently adopted in Jordan, utilizes porous or perforated piping to deliver water directly to the roots of the plants. Computers run the irrigation systems, getting information from the fields and subsequently opening or closing the appropriate valves. "This keeps evaporation and seepage losses extremely low. Because water is applied frequently at low doses, optimal moisture conditions are maintained for the crop, boosting yields, and salt does not accumulate in the root zone." (Postel, 1993, pp. 68) This method has allowed farmers to more than double their output while using the same amount of water. According to kibbutz manager Zvi Rub "7000 cubic meters of water per quarter acre were used for bananas each year when they were flood irrigated, when we started to drip-irrigate we were down to 2000 cubic meters." (Vesilind, 1993, pp. 63)

2. Wastewater Treatment

Another way in which fresh water supplies can be conserved is through the use of treated wastewater for crop irrigation.

Domestic wastewater contains many of the same chemicals that are used in fertilizer: nitrogen, phosphorus, and potassium. If properly treated, wastewater is perfectly safe for irrigating crops. This method would keep sewage out of rivers and streams, and lessen the health hazards presented by farmers using untreated, polluted river water to irrigate their fields. "Israel has pioneered in the use of recycled urban wastewater for agriculture; a project in Tel Aviv already generates enough to cultivate 20,000 acres of farmland, water that is pure enough for accidental drinking." (Vesilind, 1993, pp. 62)

VI. CONCLUSION

With the end of the Cold War, and the predictability of the bi-polar power structure, the international community is faced with the challenges of constructing new security arrangements in the face of security threats that had not heretofore been envisioned. Threats from scarcity, maldistribution, and overexploitation of the world's resources have not been recognized in the past, and will require a restructuring of international relations policies if they will be properly dealt with in the future. According to Thomas Homer-Dixon in "Environmental Change and Violent Conflict", the next half century...

> will see a global population approaching nine billion; a dramatic decrease in rich adequately irrigated agricultural land; the loss of much of the remaining virgin forests and the abundance of species they sustain; the widespread exhaustion and degradation of aquifers, rivers, and other water resources; and the collapse of many fisheries....In the next decades, environmental problems may come to dominate all other factors affecting the international system.

Homer-Dixon asserts that there may be links between environmental change and conflict; links that must be recognized by the international community.

Regional security, with the focus on environmental change, may well be the wave of the future and the only way to deal with the types of problems listed above that do not recognize territorial boundaries. It will be regional security, with support from the international community, mainly in the form of financing, that will be required to prevent conflict from occurring in the Middle

East over water. The region has a history of conflict, since the end of World War I, the drawing of artificial state boundaries, and the inclusion of a Jewish homeland in Palestine. But the region also has a history of trying to resolve its conflicts, at least over the issue of water, through participation in a long series of water management plans. The path for regional cooperation over water has been forged with the Israeli-Jordanian Peace Treaty. Now it remains for the other co-riparians to join in the discussions. As is evident from past conflicts over water, it is essential for all riparian states of the river basin to come to agreement on property rights and resource allocation, to prevent future conflicts. And, also for issues such as water management to be de-linked from the more political, and less easily solvable issues, as Palestinian independence.

Theories that analyze the linkages between water and conflict point to simple resource scarcity and maldistribution as the main causes of conflict. Regional agreements, and the intervention of international law can solve the problem of maldistribution. The problems of resource scarcity can be handled by understanding the proper role of water as an economic resource, and pricing it so as to increase the efficiency of use, and also by increasing investment in methods of acquiring new water supplies, and conserving existing supplies. Financial backing will be required to build the systems and import the technology that is needed in the region as regional actors cannot support the costs alone. Other states from within the region,

and sources from the international community must come forward with such financing, if conflict in the Jordan River basin region is to be avoided.

APPENDIX: ANNEX II OF THE 1994 ISRAEL-JORDAN PEACE TREATY

Pursuant to Article 6 of the Treaty, Israel and Jordan agreed on the following Articles on water related matters:

ARTICLE I: ALLOCATION

1. Water from the Yarmouk River

a. Summer period - 15th May to 15th October of each year. Israel pumps (12) million cubic meters and Jordan gets the rest of the flow.

b. Winter period - 16th October to 14th May of each year. Israel pumps (13) million cubic meters and Jordan is entitled to the rest of the flow subject to provisions outlined hereinbelow:

> Jordan concedes to Israel pumping an additional (20) million cubic meters from the Yarmouk in winter in return for Israel conceding to transferring to Jordan during the summer period the quantity specified in paragraphs (2.a) below from the Jordan River.

c. In order that waste of water will be minimized, Israel and Jordan may use, downstream of point 121/Adassiya Diversion, excess flood water that is not usable and will evidently go to waste unused.

2. Water from the Jordan River

a. Summer period - 15th May to 15th October of each year. In return for the additional water that Jordan concedes to Israel in winter in accordance with paragraph (1.b) above, Israel concedes to transfer to Jordan in the summer period (20) million cubic meters from the Jordan River directly upstream from the

Deganya gates on the river. Jordan shall pay the operation and maintenance cost of such transfer through existing systems (not including capital cost) and shall bear the total cost of any new transmission system. A separate protocol shall regulate this transfer.

b. Winter period - 16th October to 14th May of each year. Jordan is entitled to store for its use a minimum average of (20) million cubic meters of the floods in the Jordan River south of its confluence with the Yarmouk (as outlined in Article II). Excess floods that are not usable and that will otherwise be wasted can be utilized for the benefit of the two Parties including pumped storage off the course of the river.

c. In addition to the above, Israel is entitled to maintain its current uses of the Jordan River waters between its confluence with the Yarmouk and its confluence with Tirat Zvi/Wadi Yabis. Jordan is entitled to an annual quantity equivalent to that of Israel, provided however, that Jordan's use will not harm the quantity or quality of the above Israeli uses. The Joint Water Committee (outlined in Article IV) will survey existing uses for documentation and prevention of appreciable harm.

d. Jordan is entitled to an annual quantity of (10) million cubic meters of desalinated water from the desalination of about (20) million cubic meters of saline springs now diverted to the Jordan River. Israel will explore the possibility of financing the operation and maintenance cost of the supply to Jordan of this desalinated water (not including capital cost). Until the

desalination facilities are operational, and upon the entry into force of the Treaty, Israel will supply Jordan (10) million cubic meters of Jordan River water from the same location as in (2.a) above, outside the summer period and during dates Jordan selects, subject to the maximum capacity of transmission.

3. Additional Water

a. Israel and Jordan shall cooperate in finding sources for the supply to Jordan of an additional quantity of 50 million cubic meters per year of water to drinkable standards. To this end, the Joint Water Committee will develop, within one year from the entry into force of the Treaty, a plan for the supply to Jordan of the above mentioned additional water. This plan will be forwarded to the respective governments for discussion and decision.

4. Operation and Maintenance

a. Operation and maintenance of the systems on Israeli territory that supply Jordan with water, and their electricity supply, shall be Israel's responsibility. The operation and maintenance of the new systems that serve only Jordan will be contracted at Jordan's expense to authorities or companies selected by Jordan.

b. Israel will guarantee easy unhindered access of personnel and equipment to such new systems for operation and maintenance. This subject will be further detailed in the agreements to be signed between Israel and the authorities or companies selected by Jordan.

ARTICLE II: STORAGE

1. Israel and Jordan shall cooperate to build a diversion/storage dam on the Yarmouk River directly downstream of the point 121/Adassiya Diversion. The purpose is to improve the diversion efficiency into the King Abdullah Canal of the water allocation of the Hashemite Kingdom of Jordan, and possibly for the diversion of Israel's allocation of the river water. Other purposes can be mutually agreed.

2. Israel and Jordan shall cooperate to build a system of water storage on the Jordan River, along their common boundary, between its confluence with the Yarmouk River and its confluence with Tirat Zvi/Wadi Yabis, in order to implement the provision of paragraph (2.b) of Article I above. The storage system can also be made to accommodate more floods; Israel may use up to (3) million cubic meters per year of added storage capacity.

3. Other storage reservoirs can be discussed and agreed upon mutually.

ARTICLE III: WATER QUALITY AND PROTECTION

1. Israel and Jordan each undertake to protect, within their own jurisdiction, the shared waters of the Jordan and Yarmouk Rivers, and Arava/Araba groundwater, against any pollution, contamination, harm or unauthorized withdrawals of each other's allocations.

2. For this purpose, Israel and Jordan will jointly monitor the quality of water along their boundary, by use of jointly estab-

lished monitoring stations to be operated under the guidance of the Joint Water Committee.

3. Israel and Jordan will each prohibit the disposal of municipal and industrial wastewater into the course of the Yarmouk or the Jordan Rivers before they are treated to standards allowing their unrestricted agricultural use. Implementation of this prohibition shall be completed within three years from the entry into force of the Treaty.

4. The quality of water supplied from one country to the other at any given location shall be equivalent to the quality of the water used from the same location by the supplying country.

5. Saline springs currently diverted to the Jordan River are earmarked for desalination within four years. Both countries shall cooperate to ensure that the resulting brine will not be disposed of in the Jordan River or in any of its tributaries.

6. Israel and Jordan will each protect water systems in its own territory, supplying water to the other, against any pollution, contamination, harm or unauthorized withdrawal of each other's allocations.

ARTICLE IV: GROUNDWATER IN EMEK HA'ARAVA/WADI ARABA

1. In accordance with the provisions of this Treaty, some wells drilled and used by Israel along with their associated systems fall on the Jordanian side of the borders. These wells and systems are under Jordan's sovereignty. Israel shall retain the use of these wells and systems in the quantity and quality

detailed in Appendix 1 that shall be jointly prepared by 31st December 1994. Neither country shall take, nor cause to be taken, any measure that may appreciably reduce the yields of quality of these wells and systems.

2. Throughout the period of Israel's use of these wells and systems, replacement of any well that may fail among them shall be licensed by Jordan in accordance with the laws and regulations then in effect. For this purpose, the failed well shall be treated as though it was drilled under license from the competent Jordanian authority at the time of its drilling. Israel shall supply Jordan with the log of each of the wells and the technical information about it to be kept on record. The replacement well shall be connected to the Israeli electricity and water systems.

3. Israel may increase the abstraction rate from wells and systems in Jordan by up to 10 million cubic meters per year above the yields referred to in paragraph 1 above, subject to a determination by the Joint Water Committee that this undertaking is hydrogeologically feasible and does not harm existing Jordanian uses. Such increase is to be carried out within five years from the entry into force of the Treaty.

4. Operation and Maintenance

a. Operation and Maintenance of the wells and systems on Jordanian territory that supply Israel with water, and their electricity supply shall be Jordan's responsibility. The operation and maintenance of these wells and systems will be contract

ed at Israel's expense to authorities or companies selected by Israel.

b. Jordan will guarantee easy unhindered access of personnel and equipment to such wells and systems for operation and maintenance. This subject will be further detailed in the agreements to be signed between Jordan and the authorities or companies selected by Israel.

ARTICLE V: NOTIFICATION AND AGREEMENT

1. Artificial changes in or of the course of the Jordan and Yarmouk Rivers can only be make by mutual agreement.

2. Each country undertakes to notify the other, six months ahead of time, of any intended projects which are likely to change the flow of either of the above rivers along their common boundary, or the quality of such flow. The subject will be discussed in the Joint Water Committee with the aim of preventing harm and mitigating adverse impacts such projects may cause.

ARTICLE VI: CO-OPERATION

1. Israel and Jordan undertake to exchange relevant data on water resources through the Joint Water Committee.

2. Israel and Jordan shall co-operate in developing plans for purposes of increasing water supplies and improving water use efficiency, within the context of bilateral, regional or international co-operation.

ARTICLE VII: JOINT WATER COMMITTEE

1. For the purpose of the implementation of this Annex, the Parties will establish a Joint Water Committee comprised of three members from each country.

2. The Joint Water Committee will, with the approval of the respective governments, specify its work procedures, the frequency of its meetings, and the details of its scope of work. The Committee may invite experts and/or advisors as may be required.

3. The Committee may form, as it deems necessary, a number of specialized sub-committees and assign them technical tasks. In this context, it is agreed that these sub-committees will include a northern sub-committee and a southern sub-committee, for the management on the ground of the mutual water resources in these sectors.

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